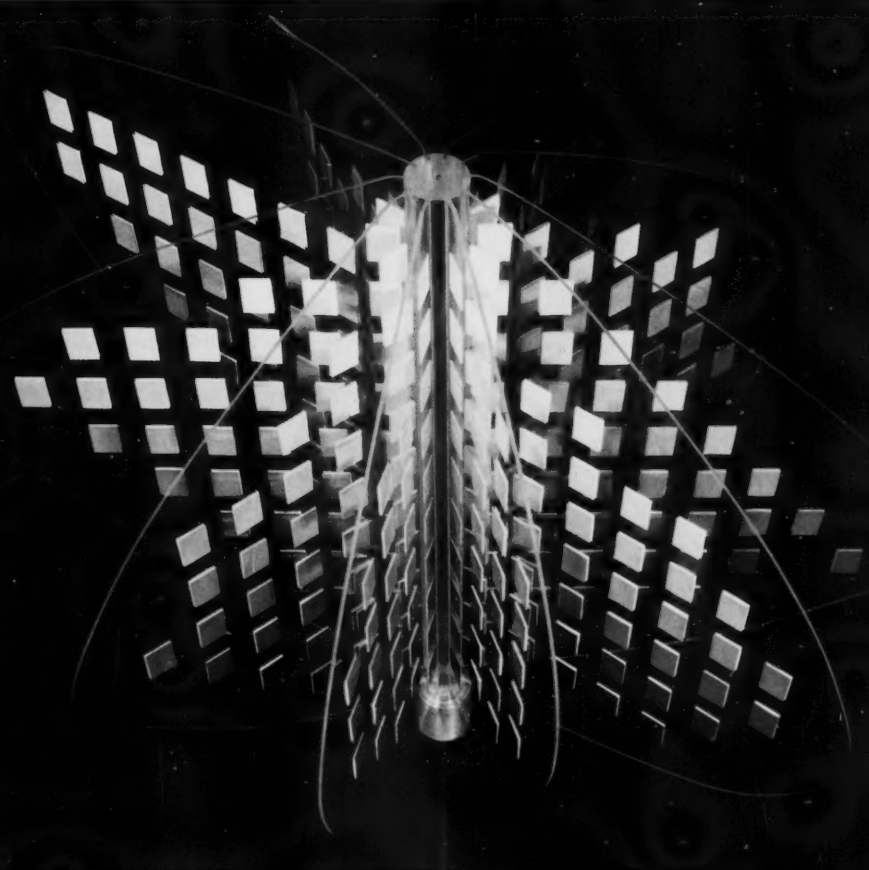
NATIONAL BUREAU OF STANDARDS

Technical News Bulletin

May/1965



U.S. DEPARTMENT OF COMMERCE

New NBS Color Charts Available

Eighteen new color charts for the use of color scientists and color technologists are now available from the Bureau. Each chart contains a set of inch-square glossy chips illustrating the color gamut of a particular hue name ranging, for example, from greenish black to greenish white to deep green to brilliant green.

When used in conjunction with NBS Circular 553, the ISCC–NBS Method of Designating Colors and a Dictionary of Color Names,[1] the charts will provide a ready means for visualizing the actual colors corresponding to any of thousands of different color names. The charts may be ordered as Standard Material No. 2106 from the Office of Standard Reference Materials, National Bureau of Standards, Washington, D.C., 20234, at $3 a set.

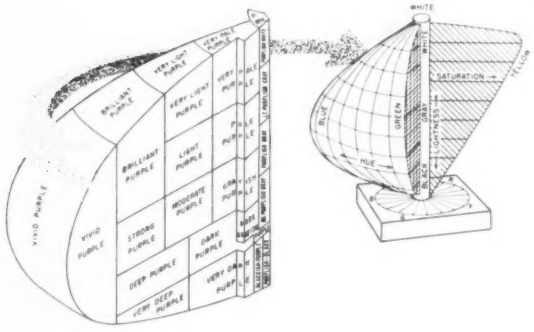
The development of these charts is the outcome of a joint project undertaken a number of years ago by the Inter-Society Color Council (ISCC) and the Bureau to devise a simple unambiguous system of color designations.[2] In this work, Deane B. Judd and Kenneth L. Kelly of the NBS colorimetry laboratory divided the psychological color solid* into blocks (see below) whose boundaries were carefully specified in terms of the Munsell scales of hue, value, and chroma.[3]

The blocks were assigned simple hue names such as blue, green, orange, or yellow, with one or more modifiers such as grayish, light, dark, or strong. The size of each block was designed to encompass color variations that would be acceptably described by the particular color name assigned to it. The system and the color vocabulary were slightly revised and incorporated in NBS Circular 553. In the dictionary part of the circular, the many different color names from the various color-order systems now used in science and industry are listed under the corresponding color-name block headings.

In order to determine the most representative colors to illustrate the color-name blocks, the centers of gravity or centroids of these blocks were computed[4] in terms of the Munsell scales. With pigments presently available, paint-on-paper prototypes were produced for 251 of the 267 centroid colors.[5] The prototypes were then reproduced as sets of chips and affixed to charts.[6] The charts were designated by hue names following the spectral order all the way from red and pink to violet, followed by purple and purplish red.

Each set of the charts is issued with a table listing the number of the chip, the color name assigned to it, and its appropriate Munsell notation. The charts may thus be applied for many purposes requiring color specification. For example, they may be used—together with Circular 553—to describe the colors of drugs and chemicals, or they may be applied in qualitative chemical analysis, in dermatology, and in the description of mica, building materials, soils, and rocks. They are well suited for studies of trends in color usage, for planning lines of merchandise intended to have coordinated colors, and for standardizing the colors of manufactured goods such as textiles, paints, plastics, papers, and ceramics.

Of possibly even greater significance is their projected utility as an integral part of a universal color language.[7] Through this color language, colors and color differences may be described with any degree of accuracy necessary in science or industry. Such accuracies are equivalent to dividing the color solid into as few as 13 large parts to as many as 5 million small parts, with an appropriate color designation for each one. The color names and thus the color chips of other color-order systems are correlated with the color language through the dictionary part of Circular 553.



Psychological color solid, one quarter removed to show the vertical axis. On the left is a segment of the solid from the purple area; its color-name blocks reflect varying degrees of hue, lightness, and saturation—expressed in terms of the Munsell hue, value, and chroma scales.

*A three-dimensional representation used by scientists to illustrate the relationships among colors perceived by the human eye.

[1] Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402 ($2.00).

[2] Method of designating colors, by Deane B. Judd and Kenneth L. Kelly, J. Res. NBS **23**, 355 (1939) RP1239.

[3] A color notation by A. H. Munsell, 11th ed., Munsell Color Co., Inc., 2441 North Calvert Street, Baltimore, Md. (1961).

[4] Central notations for the revised ISCC–NBS color-name blocks, by Kenneth L. Kelly, J. Res. NBS **61**, 427 (1958) RP2911; also NBS Tech. News Bull. **43**, 97 (1959).

[5] Produced by the Davidson and Hemmendinger Laboratories, Easton, Pa.

[6] Reproductions carried out by the Tobey Color Card Co., St. Louis, Mo.

[7] A universal color language, by Kenneth L. Kelly, Color Engineering (in press).

NATIONAL BUREAU OF STANDARDS

Technical News Bulletin

U.S. DEPARTMENT OF COMMERCE
John T. Connor, Secretary
NATIONAL BUREAU OF STANDARDS
A. V. Astin, Director

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Subscription price: domestic, $1.50 a year; 75 cents additional for foreign mailing; single copy, 15 cents. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (June 19, 1961).

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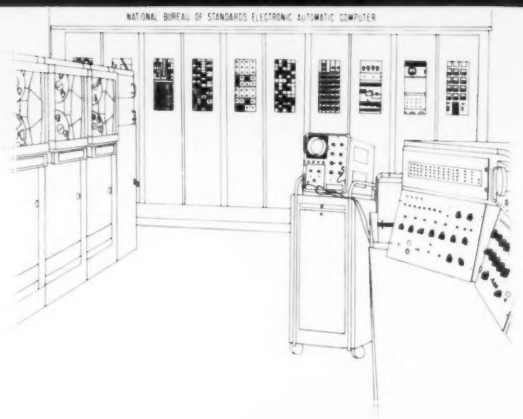
COVER: Model of the color solid divided into 10 segments. This model, constructed at NBS to illustrate color gradations, contains chips illustrating the Munsell scales of hue, value, and chroma. The color chips shown are taken from the new set of color charts.

Smithsonian receives

HISTORIC COMPUTER PARTS



After 15 years of service, one of the Nation's pioneer electronic computers, SEAC, reached its final resting place on February 24. In a small ceremony held in the computer laboratory of the Bureau, Dr. A. V. Astin, NBS Director, presented typical parts of SEAC to Dr. Walter F. Cannon, Curator in Charge, Division of Physical Sciences, of the Smithsonian Institution. The parts were from the computer's memory, computing unit, and control console.

When completed at NBS in 1950, SEAC (*S*tandards *E*lectronic *A*utomatic *C*omputer) was the first internally programmed digital computer to go into operation in the United States.[1] Developed originally to enable the Air Force to attack massive logistic problems, SEAC was also used to perform computations required in the design of the first H-bomb.

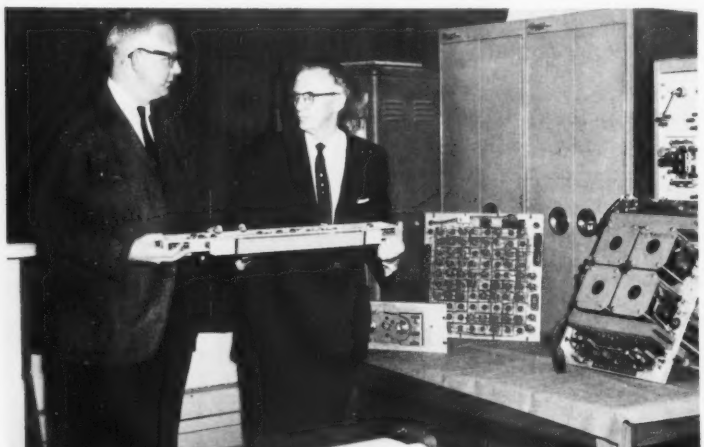
SEAC has since been used in a wide variety of computer research, including experimentation in automatic searching of chemical patents and the manipulation of pictorial data, and in such novel tasks as moving "cars" on streets existing only in the computer memory. SEAC also demonstrated the feasibility of techniques which contributed to successive generations of computers.

Current problems and experiments now require the higher speeds and greater memory capacities of the more modern machines. Because of this, SEAC was "retired" in a special ceremony April 23, 1964.[2] At that time many of the group which originally developed and built the machine gathered at the Bureau to bid the machine farewell.

Now, SEAC is physically disappearing. It is being dismantled, and except for those parts going to the Smithsonian for display, its usable remains will be scattered through Government surplus distribution.

[1] SEAC, the National Bureau of Standards Eastern Automatic Computer, *NBS Tech. News Bull.* **34,** *121–125 (Sept. 1950)*; SEAC improvements increase computing power, *NBS Tech. News Bull.* **38,** *8–13 (Jan. 1954)*; and Electronic Computer Research issue of the *NBS Tech. News Bull.* **42,** *57–66 (April 1958)*.

[2] NBS pioneer digital computer retired, *NBS Tech. News Bull.* **48,** *112–114 (July 1964)*.



Dr. A. V. Astin (*right*) presents a unit of SEAC's memory to Dr. Walter F. Cannon, the curator in charge of physical science exhibits at the Smithsonian Institution. The mercury-tube memory will be exhibited in the Smithsonian's Museum of Science and Technology, as will the wire transport behind Dr. Astin, a panel of logic circuitry, and a Williams-tube memory unit.

NBS calibrates

THREE GIANT LOAD CELLS

Calibration of three 5,000,000-lb capacity compression-tension load cells has recently been completed at the NBS Institute for Basic Standards. These cells are to be used in static firing tests to determine rocket engine thrust of the much larger and more powerful rocket engines expected as a result of the expanding space program.

The three cells,[1] employed together on a huge static test stand, will measure thrust during firing tests of a 260-inch-diameter solid propellant rocket motor being developed for the Air Force. The first engine scheduled to be tested, in 1965, is approximately 80 feet in length and is expected to develop a thrust of about three million pounds. The cells will be attached to a movable platform that can be positioned vertically in a 150-foot-deep by 52-foot-diameter concrete test firing shaft.

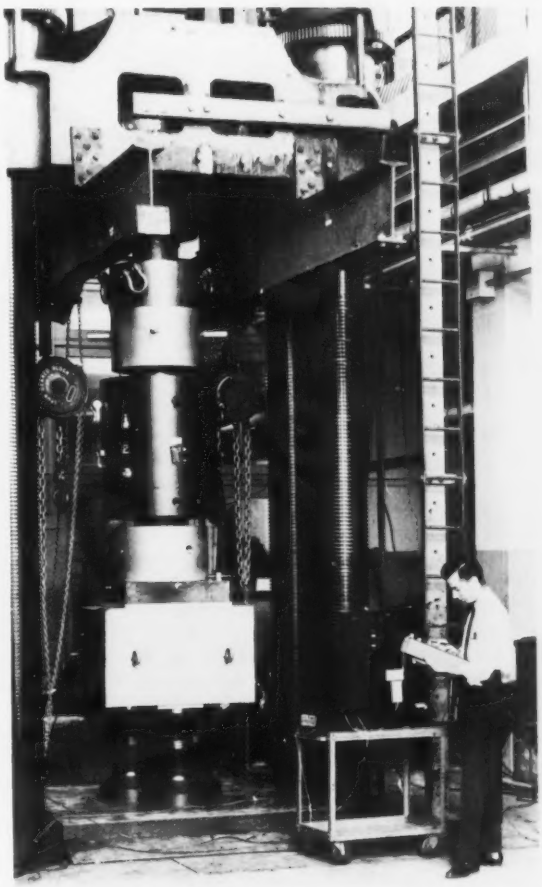
A ten-million-pound capacity hydraulic testing machine located in the Institute's Engineering Mechanics Laboratory was used to apply the test loads. The applied loads were measured by means of three 3,000,000-lb capacity dynamometers maintained by this Laboratory. The errors of the loads applied during the calibration did not exceed 0.3 of one percent.

A unique feature of the calibration was that the cells were calibrated at both room temperature and a temperature in the range of 135–150 °F. This was necessary since the solid propellant fuel for the rocket engine is cured and kept at approximately 150 °F until ignition. Calibration at the higher temperature therefore insured the establishment of performance characteristics for the cells under intended operating conditions.

During the tests seven men were required: one man to read the output of the cell, one each for the readout equipment associated with the three NBS force standards, one performing necessary calculations, and one or two men controlling the hydraulic testing machine.

With the 1,000,000-lb capacity deadweight testing machine now being installed at the new Bureau site in Gaithersburg, Md., the calibration accuracy of large force standards, such as the dynamometers, will be improved by elimination of steps required to extend the range of the present 111,000-lb capacity deadweight testing machine to 1,000,000 lb. More accurate calibration of large capacity load cells will then be possible. Studies by contractors engaged in the development of large boosters have shown that increased accuracy in force measurements would reduce the number of costly tests required to demonstrate the repeatability of the total impulse specified for a propulsion system—and thus result in savings of millions of dollars.

[1] *Manufactured by Baldwin-Lima-Hamilton Electronics, a division of Baldwin-Lima-Hamilton Corporation, Waltham, Massachusetts.*



Arnold J. Mallinger adjusts the strain gage circuit inside the cell to obtain balance.

Atomic Weights Redetermined by Mass Spectrometry

RECOGNIZING THE increasing need for more accurate atomic weights, the Bureau recently reevaluated the atomic weights of silver,[1] chlorine,[2] bromine,[3] and copper.[4] The values obtained are based on accurate mass spectrometric determinations of the absolute isotopic compositions of these elements. This work was sponsored jointly by NBS and the Atomic Energy Commission.

The new value of 79.90363 ± 0.00092 ($C^{12}=12$)[5] for bromine differs significantly from the presently accepted one of 79.909 ± 0.002. The other NBS values are close to the atomic weights now accepted but are stated with less uncertainty. The uncertainties presented with the absolute isotopic abundance ratios and the atomic weights are overall limits of error based on 95 percent confidence limits for the mean, and take into account effects of known sources of possible systematic error. The new values for bromine and copper will be considered by the International Commission on Atomic Weights when preparing their 1965 report; the silver and chlorine values have already been reviewed.

Silver, chlorine, and bromine were chosen for study because of their widespread use in determining atomic weights of other elements. Copper was selected on the basis of its extensive industrial applications. (An investigation of magnesium is currently under way for this reason.)

Mass spectrometer used for the determination of the atomic weights of silver, chlorine, bromine, and copper. Part of the large magnet used for deflection of the beam can be seen behind the top of the metallic Dewar at the left.

Physical determinations of the atomic weights of silver, chlorine, and bromine using mass spectrometric methods provide a means—independent of the classical combining weight methods—to establish the exact weight relations among these elements. In addition, accurate mass spectrometric isotopic abundance ratios serve as a calibration standard for the relative results obtained by various investigators and frequently resolve the question of possible natural variations in isotopic abundances.

Once accurate values were obtained for the absolute isotopic compositions of the four elements, the atomic weights of the reference samples were readily calculated from these values and the corresponding nuclidic masses.[6]

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[1] Absolute isotopic abundance ratio and the atomic weight of silver, *by W. R. Shields, D. N. Craig, and V. H. Dibeler, J. Am. Chem. Soc.* **82,** *5033–5036 (Oct. 5, 1960). Also:* Atomic weight of silver redetermined, *NBS Tech. News Bull.* **44,** *53–55 (April 1960).*

[2] Absolute isotopic abundance ratio and the atomic weight of chlorine, *by W. R. Shields, T. J. Murphy, E. L. Garner, and V. H. Dibeler, J. Am. Chem. Soc.* **84,** *1519–1522 (May 16, 1962).*

[3] Absolute isotopic abundance ratio and the atomic weight of bromine, *by E. J. Catanzaro, T. J. Murphy, E. L. Garner, and W. R. Shields, J. Res. NBS* **68A** *(Phys. and Chem.) No. 6, 593–599 (Nov.–Dec. 1964).*

[4] Absolute isotopic abundance ratio and the atomic weight of a reference sample of copper, *by W. R. Shields, T. J. Murphy, and E. L. Garner, J. Res. NBS* **68A** *(Phys. and Chem.) No. 6, 589–592 (Nov.–Dec. 1964).*

[5] New unified scale adopted for atomic weights, *NBS Tech. News Bull.* **46,** *34–35 (Feb. 1962).*

[6] Relative nuclide masses, *by F. Everling, L. A. Konig, J. H. E. Mattauch, and A. H. Wapstra, Nuclear Physics* **18,** *529–569 (Sept. 2, 1960).*

Electrical Engineering Units and Constants

The National Bureau of Standards has compiled a list of electrical engineering symbols and units which will constitute the Bureau's standard editorial practice for use in all its publications. The list is given in table 1 for the convenience of scientists and engineers who may find it useful in their work.[1]

TABLE 1. *Electrical engineering symbols and units*

Quantity	Symbol	Unit	Symbol
charge	Q	coulomb	C
current	I	ampere	A
voltage, potential difference	V	volt	V
electromotive force	$\mathcal{E}$	volt	V
resistance	R	ohm	Ω
conductance	G	mho (siemens)	A/V, or mho(S)
reactance	X	ohm	Ω
susceptance	B	mho	A/V, or mho
impedance	Z	ohm	Ω
admittance	Y	mho	A/V, or mho
capacitance	C	farad	F
inductance	L	henry	H
energy, work	W	joule	J
power	P	watt	W
resistivity	ρ	ohm-meter	Ωm
conductivity	σ	mho per meter	mho/m
electric displacement	D	coulomb per sq. meter	C/m²
electric field strength	E	volt per meter	V/m
permittivity (absolute)	ϵ	farad per meter	F/m
relative permittivity	ϵ_r	(numeric)	
magnetic flux	Φ	weber	Wb
magnetomotive force	$\mathcal{F}$	ampere (ampere-turn)	A
reluctance	$\mathcal{R}$	ampere per weber	A/Wb
permeance	$\mathcal{P}$	weber per ampere	Wb/A
magnetic flux density	B	tesla	T
magnetic field strength	H	ampere per meter	A/m
permeability (absolute)	μ	henry per meter	H/m
relative permeability	μ_r	(numeric)	
length	l	meter	m
mass	m	kilogram	kg
time	t	second	s
frequency	f	hertz	Hz
angular frequency	ω	radian per second	rad/s
force	F	newton	N
pressure	p	newton per sq. meter	N/m²
temperature (absolute)	T	degree Kelvin	°K
temperature (International)	t	degree Celsius	°C

The Bureau has also compiled a list of symbols for some of the important physical constants for use by NBS authors in the electrical engineering field. These symbols, together with rounded values of the constants, are given in table 2.

TABLE 2. *Physical constants used in electrical engineering*

Constant	Symbol	Rounded value
electronic charge	e	1.602×10^{-19} C
speed of light in vacuum	c	2.9979×10^{8} m/s
permittivity of vacuum, electric constant	ϵ_0, Γ_e	8.8542×10^{-12} F/m
permeability of vacuum, magnetic constant	μ_0, Γ_m	$4\pi\times10^{-7}$ H/m†
Planck constant	h	6.63×10^{-34} J·s
Boltzmann constant	k	1.38×10^{-23} J/°K
Faraday constant	F	9.649×10^{4} C/mol
proton gyromagnetic ratio	γ	2.6752×10^{8} rad/sT
standard gravitational acceleration	g_n	9.80665 m/s²†
normal atmospheric pressure	atm	101 325 N/m²†

†Defined value.

[1] *For convenient reference, this list and the list of physical constants given in table 2 are being printed on a wallet-size card. This card will supplement the General Physical Constants card, NBS Misc. Publ. 253, for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, for 5 cents each or $2.50 per 100.*


CAUTION
FREQUENT STOPS
LANTERN BATTERY
BATTERY
6
7
8
TIRE
AXLE
WHEEL

New pe

pecifications for Odometers

To Improve Mileage Registrations of Rental Cars

Distances traveled by rental cars will be more accurately registered than they have been in the past, as the result of a recent study at the NBS Institute for Applied Technology. The findings revealed that the mileage registration errors of these devices exceeded the tolerances allowed by weights and measures regulations for odometers used commercially.[1] New test procedures were devised for the study, and the data indicated that the average error could be reduced to near zero. Hence, new rental car odometer specifications based on these findings are now in effect. The automobile industry also plans to incorporate the higher accuracy requirement in specifications for all mileage-measuring devices on U.S.-manufactured passenger cars.

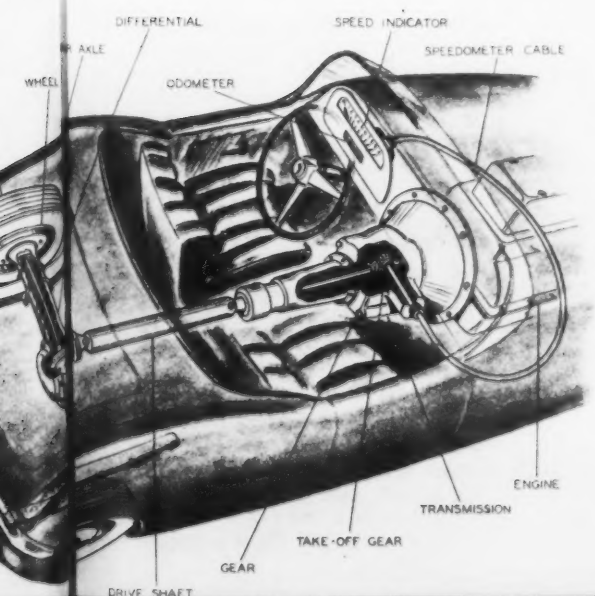
The official weights and measures regulations adopted by State and local jurisdictions allowed odometer overregistration errors (1-percent maximum) only in the case of worn tires, and allowed a maximum underregistration error of 4 percent. Industry specifications, on the other hand, allowed overregistration errors up to 5 percent. The recent phenomenal growth of the rental-car industry generated many user complaints of odometer overregistrations during the past few years. At the request of the Committee on Specifications and Tolerances of the National Conference on Weights and Measures, Donald R. Mackay of the NBS Office of Weights and Measures initiated a detailed study of the problem during the summer of 1962.[2]

In order to establish a working standard of length, a distance of 1 mile on an unopened section of a new freeway was precisely measured and marked off. A "fifth-wheel" device, fitted with an electromagnetic counter that indicated distances in thousandths of a mile, was attached to the rear of an automobile and calibrated in several two-direction runs made over the 1-mile course. Data thus obtained provided correction factors that were applied to the fifth-wheel indications obtained in the actual testing of vehicle odometers.

Tests were then carried out on rental cars chosen at random from those commercially available. Of the 48 cars whose odometers were evaluated during the study, 32 were popular-size cars and compacts, 13 were luxury-type cars, and 3 were station wagons. A 4-mile course over city streets and a 4-mile course on a highway were used for the tests.

After each car undergoing test arrived at the NBS Washington laboratory grounds, tire tread depths and tire pressures were determined and recorded. Tire pressures were then adjusted to 24 psi and the fifth

(*Continued on p. 79*)



Top, left: **Fifth wheel used in the tests. A battery-operated electrical counter is shown.** ***Center, left:*** **Technician adjusts the tire pressure in the fifth-wheel device used for this evaluation.** ***Bottom, left:*** **Odometer indicating mechanism and gears.** ***Bottom, right:*** **Schematic diagram of odometer activating mechanism in an automobile. (Odometer picture and diagram courtesy of Stewart-Warner Corp.)**

CLEARINGHOUSE
FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION

This column is being established to provide readers of the Technical News Bulletin *with information about the operation of the Clearinghouse and the services available. For additional information on any Clearinghouse service, write to Customer Relations Branch, Clearinghouse for Federal Scientific and Technical Information, U.S. Department of Commerce, Springfield, Va. 22151.*

Central Source of Government Technical Information for Industry

The Clearinghouse for Federal Scientific and Technical Information is a system for supplying the industrial and technical community with information about Government-generated science and technology in defense, space, atomic energy, and other national programs. This facility, a part of the NBS Institute for Applied Technology, is a central source for reports on the results of Federal work in the physical sciences and engineering; it is comparable to similar Government centers in agricultural and health research.

Principal missions of the Clearinghouse are to collect, organize, and distribute unclassified and not otherwise limited technical reports and translations produced by all Government agencies; to provide information on Federal research in progress; and to operate a referral service to sources of specialized technical information. The document collection and distribution program incorporates the technical information functions of the former Office of Technical Services.

Reports and Translations

During the current fiscal year ending June 30, approximately $15 billion will be spent on Federal research and development. The Clearinghouse will collect some 54,000 research reports and translations on a large proportion of this work from the Department of Defense, National Aeronautics and Space Administration, Atomic Energy Commission, and other agencies; it will disseminate a million copies of the reports. Both collection and dissemination figures are expected to be considerably higher in the next fiscal year.

The Clearinghouse now processes all unclassified and unlimited Department of Defense documents and makes distribution to defense contractors, a function formerly performed by the Defense Documentation Center. Contractors continue to make their requests for documents to the Center, but the orders are filled by the Clearinghouse.

All collected documents are available to the public at the cost of reproduction and handling. Reproduction is offered, at the purchaser's choice, in two forms—"*hard copy*" and *microfiche*. Hard copy is produced by printing or by "blowback" from microfilm. Microfiche is a 4 x 6 in. sheet of film which may contain 57 or more pages. It has several advantages over hard copy and microfilm, including cost and convenience in storage and retrieval. Microfiche readers and reader-printers are available from a number of manufacturers in the United States and abroad.

Newly collected research reports are announced every 2 weeks in *U.S. Government Research and Development Reports* (sold by Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at $15 per year, $3.75 additional for foreign mailing). Several new features have just been incorporated in this publication. One is the abstracting of Government-owned patents available for license by the public on a nonroyalty, nonexclusive basis, and of selected private patents. The area of lubricants has been chosen as a starting point in abstracting private patents, but other subjects will be added as resources permit.

New translations available from the Clearinghouse, as well as from other sources, are listed every 2 weeks in *Technical Translations* (sold by Superintendent of Documents at $12 a year, $4 additional for foreign mailing).

The Clearinghouse has begun publication of a *Government-wide Index to Federal Research and Development Reports*. This service will provide scientists, engineers, research managers, and librarians with a single source index to new Government technical information. Reports are indexed by subject, author, source, and report number.

Two new information services have been inaugurated. These are the "*Fast Announcement Service*" and the "*Package*" program. Through the Fast Announcement Service, firms and individuals may receive direct mail announcements of new reports in their fields of interest, the reports having been selected for their industrial significance. There is no cost for this service.

The Package program is an effort to repackage individual reports on particular subjects. A review of pertinent documents acquired over the past 2 years is made, the most important reports on a specific technical development are selected, and a critical review is written. The review, with bibliographies, is published as a separate document and is sold by the Clearinghouse for 50 cents. Production target is 70 of these reviews a year.

These two services are available directly from the Clearinghouse. They may also be obtained, however, through regional development groups, universities, and

Clearinghouse—Continued

other organizations which are cooperating in a new regional information dissemination program.

Also provided are two types of bibliographic services. In the first, selective bibliographies are periodically prepared on general subjects of wide industrial and scientific interest and distributed free of charge. The second is a *Literature Searching Service*, for which the Clearinghouse charges $11 per hour of searching time. Through the latter service, a firm may obtain a periodic "current awareness" bibliography in a specific subject area, or a "retrospective" bibliography covering a period of time specified by the firm.

Current Research

The Clearinghouse is planning a new announcement journal on Government research and development in progress, with publication scheduled to begin soon. Listings will be by project, title, performing organization, principal investigators, term of contract or grant, and descriptive research terms. The Science Information Exchange of the Smithsonian Institution will cooperate in this effort by furnishing a copy of each Notice of Research Project it prepares in the physical sciences and engineering. The new publication should help the industrial and technical community, as well as Government, to avoid duplication of technical work already in progress.

Referral Services

A master file of information sources in the physical sciences and engineering has been established. These sources include both Government-sponsored centers and private industry. Inquirers are referred to the sources most likely to have the information needed to answer a specific technical question. The Clearinghouse cooperates with the National Referral Center (Library of Congress) in providing this service.

Future Programs

Some services now in planning for the future are:

- Subscription sales of Government reports by industrial categories.
- Sales of magnetic computer tapes containing document retrieval data on new reports added to the Clearinghouse collection.
- Subscription sales of catalog cards on documents collected by the Clearinghouse.

Odometers—Continued

wheel was attached to the rear bumper. The car was then driven slowly until the operator saw the top edge of either the 5- or the 7-tenths-mile figure appear at the bottom edge of the odometer window frame. The vehicle was stopped when the edge of the number and the edge of the odometer window frame were in exact coincidence. The fifth wheel was then energized, the counter was zeroed, and a warning signal mounted on the rear of the car was also energized. The car was then driven over the test courses in both directions to verify the mileage registration.

Data obtained from these tests showed that the average mileage overregistration for all the rental cars was +3.21 percent. The average difference between the city test and the highway test was 0.6 percent, with the odometers indicating more overregistration for the city than for the highway runs. It was found that variables such as wet pavements and additional vehicle loads tended to increase the overregistration error while increased vehicle speeds and higher tire pressures tended to decrease this error.

The odometers on several trucks—both commercial and noncommercial—were also evaluated in this study under essentially the same test conditions as those used for the rental cars. The average error found over the same test course was +0.8 percent. Increased speeds did not significantly influence this error under any conditions; however, increased tire pressures caused a decrease in odometer readings, and increased loads caused an increase in these readings.

A comparison was made of the results obtained with the fifth-wheel device and of those obtained with other test methods. These included a road test, a simulated-road test, and a wheel test in which a revolution counter is actuated by the turning of a rear wheel while the vehicle remains stationary. The comparison showed that the fifth-wheel test provided the most accurate results, and that the wheel test—previously specified as an acceptable method of test—gave unsatisfactory results. The road test had a slightly lower precision than the fifth-wheel test and required more time and effort.

The simulated-road test produced satisfactory results when cars equipped with normal four-ply tires were tested. When vehicles equipped with two-ply (four-ply rating) tires were tested, however, the simulated-road test produced data that were not comparable to the actual road tests. The differences between test results were attributed to the additional distortion caused by two-ply tires on the rollers of the simulator, as compared with the normal distortion of the tires on road surfaces. Thus, the simulated-road tests cannot be recommended for the testing of odometers installed in vehicles equipped with two-ply tires.

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[1] Specifications, Tolerances, and Regulations for Commercial Weighing and Measuring Devices, *NBS Handbook 44, second ed. (1955, corrected through 1961), available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 ($1.25)*.

[2] *For further details, see* Report on Technical Investigation of Odometers, *by Donald R. Mackay, NBS Tech. Note 195 (1963), available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (25¢)*.

JILA expedition to cover SOLAR ECLIPSE

The Joint Institute for Laboratory Astrophysics (JILA) at Boulder, Colo., is sending a party of scientists to the South Pacific with newly designed apparatus to gather data on the total solar eclipse occurring on May 30, 1965. JILA is operated jointly by the Bureau and the University of Colorado.

The new apparatus, a photoelectric spectrometer, was conceived and designed mainly by J. E. Faller of the NBS Laboratory Astrophysics Division at JILA and Professor J. T. Jefferies of the University of Hawaii (nonresident fellow of JILA and part-time staff member of the Laboratory Astrophysics Division).

Two models of the apparatus are being assembled at JILA for use on the eclipse expedition; they are designed to look at somewhat different spectral regions but will have some overlap. One of the instruments is to be part of a group of complementary experiments being carried out between JILA, the University of Hawaii, and the Air Force Sacramento Peak Observatory. According to present plans, this instrument will be used on the French island of Bellingshausen. In addition, JILA scientists will make observations on the New Zealand island of Manuae using the second of the two instruments in collaboration with colleagues from the University of Pennsylvania and the New Zealand Mount John Observatory. The expedition will be sponsored by NBS, the National Aeronautics and Space Administration, and the Sacramento Peak Observatory.

The eclipse will occur on a path through French Polynesia and will provide the longest period of totality for about 10 years. If the weather is clear over the eclipse path, there will be an opportunity to make studies of the structure of the outer atmosphere of the sun which cannot be made at any other time.

An extremely important part of the sun's atmosphere is the chromosphere, the transitional layer between the bright disk of the sun and the million-degree solar corona reaching out into space. The faint light from the chromosphere can reveal details of the surface storms on the sun—flares, eruptions, and other phenomena which produce direct effects on the earth's atmosphere through particle and x-ray bombardment. In addition, the chromosphere produces most of the ultraviolet and x radiation which steadily maintains the ionosphere and thus makes possible circumglobal radio communication.

An eclipse is essential for study of the chromospheric layer because this layer is very thin in comparison with the sun's disk (which is about 100 times as thick as the layer) and consequently the observer must resolve what appear to be very small heights above the edge of the sun. Normally, poor atmospheric "seeing" prevents this resolution, but during an eclipse the moon blocks out the main light of the sun's disk. Because the moon lies outside of the earth's atmosphere, the "seeing" problem is then largely eliminated.

Astronomers have previously studied the spectrum of the chromosphere using photographic instruments which analyze the chromospheric light into its component colors. But as the solar atmosphere changes very rapidly just in this region, these measurements did not have the accuracy nor the height resolution required to follow with sufficient precision the changes, with height, of important properties of the sun such as temperature and electron density.

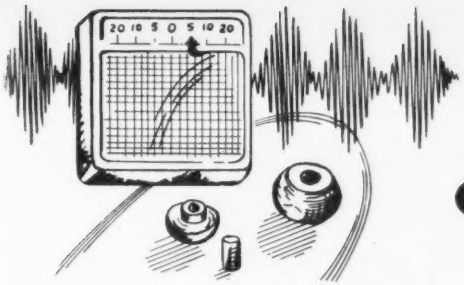
The new instrument developed by JILA scientists is designed to permit a tenfold improvement in measurements of the variation of radiation intensity with height above the solar surface. This photoelectric spectrometer will automatically follow changes in the intensity of different selected colors from the chromosphere as the moon's edge gradually passes through the outer solar atmosphere.

Atomic Weights—Con.

TABLE 1. *Isotopic abundance ratios and atomic weights*

NBS absolute isotopic abundance ratios*		NBS atomic weights ($C^{12}=12$)*	International atomic weights** ($C^{12}=12$)
Silver	$Ag^{107}/Ag^{109}=1.07597\pm0.00135^{7}$ ***	107.8682 ±0.0010**	107.870±0.003
Chlorine	$Cl^{35}/Cl^{37}=3.1272\begin{cases}\pm0.0079\\0.0082\end{cases}$	35.45273 $\begin{cases}+0.00092**\\-0.00097\end{cases}$	35.453±0.001
Bromine	$Br^{79}/Br^{81}=1.02784\pm0.00190$	79.90363 ±0.00092	79.909±0.002
Copper	$Cu^{63}/Cu^{65}=2.2440\ \pm0.0021$	63.54555 ±0.00040	63.54

*Determined from mass spectrometric investigations by the NBS Physical Chemistry Division.
**Adopted by the International Union of Pure and Applied Chemistry—1961.
***Indicated uncertainties are overall limits of error based on a 95-percent confidence limit for the mean and include an allowance for effects from known sources of systematic errors.



Standards and Calibration

Calibration Instructions Available

The Bureau of Naval Weapons has for some time been preparing and issuing detailed instructions on the calibration and use of laboratory instruments. Nearly 300 of these procedures are available through the NBS Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151. A listing of the title and price of each procedure is available on request from the Clearinghouse. Ask for information on the Navy Instrument Calibration Series.

Attenuation in Coaxial Components from 200 MHz to 12 GHz

The Radio Standards Laboratory announces that calibration services for the measurement of attenuation of coaxial attenuators and couplers has been extended continuously in frequency to 12 GHz from the former maximum of 8 GHz. The range is also extended downward in frequency to 200 MHz from the former limit of 300 MHz. Measurements are made over an attenuation range of 60 dB, with an uncertainty in measurement of 0.1 dB/10 dB of attenuation.

Recent improvements in coaxial components, and particularly in the development of precision connectors, have increased the usefulness of coaxial equipment for precision work at much higher frequencies than was possible heretofore. Development work is in progress in the Radio Standards Laboratory to extend attenuation measurements above 12 GHz in order to meet the increasing demand for calibration services at higher frequencies.

New Calibration Service: Ratio Factor of Pulse Voltage Dividers

The NBS High Voltage Laboratory announces the availability of a service for determining the ratio factor of pulse-voltage dividers under single pulse conditions. The calibrating pulse used is about 12.5 microseconds long with a risetime of about 1 microsecond. Available peak pulse voltages are 20, 40, 60, 80, and 100 kilovolts; however, the calibration is made at a point on the pulse which is about 10 percent lower than the peak.

Accuracy of calibration depends to some extent on the divider submitted; in general, it is in the range of 1 to 3 percent. The fee for the calibration depends upon the actual time required and is expected to average less than $100.

It is requested that those planning to use this calibration service write in advance giving full details regarding the divider to be submitted and the associated measuring equipment normally used with it. Correspondence should be addressed to the High Voltage Section, Electricity Division, National Bureau of Standards, Washington, D.C. 20234.

IEEE Communications Convention at Boulder

More than 1,500 attendees are expected at a Communications Convention at the University of Colorado campus, Boulder, Colo., June 7–9. The Convention is sponsored by the Communication Technology Group of the Institute of Electrical and Electronics Engineers in cooperation with the Bureau and the University. IEEE groups on Information Theory, Audio, and Space Electronics/Telemetry will also participate.

The Convention will consist of 30 general sessions, 8 sessions of the 7th International Symposium on Global Communications, and an 8-session Information Theory Symposium. Accommodations and meals for attendees and their families will be available at the University; reservations and convention registration fees ($15 for IEEE members, $18 for nonmembers, and $2 for students) should be sent before May 29 to:

Bureau of Continuation Education
328 University Memorial Center
University of Colorado
Boulder, Colo. 80304

Standardization Study Released

Standards Institute Proposed

A Department of Commerce advisory group of leading industrial technologists recently recommended that a new federally chartered Institute be established to coordinate voluntary standardization activities in the United States. In a report presented to Secretary of Commerce John T. Connor, the group also recommended that the Commodity Standards Program of the National Bureau of Standards be continued, in order to provide standardization services not otherwise available.[1]

Headed by Dr. Francis L. LaQue, Vice President of the International Nickel Co., Inc., the group functioned as a panel of the Department of Commerce Technical Advisory Board. It was given a broad mandate to review the Nation's requirements for industrial and commodity standards and to make recommendations toward meeting the Nation's needs in this field.

The panel stated that the development of standards should be left to the private organizations already active in the field. Such organizations were found to be competent, effective, and aware of the continuing need for a dynamic standards activity responsive to the requirements of modern society.

Recommendations were made that legislation be sought to create the new Institute, and that standards voluntarily developed by standards organizations, and issued by the new Institute, be designated "USA Standards." The report stated that preference should be given to reconstituting the existing national standards organization, the American Standards Association (ASA), rather than to creating an entirely new body. It also stated that the organizational structure, staff, and financing should be at a level substantially greater than that at which ASA is now operating. The proposed Institute would include a Division of Consumer Affairs.

The panel's study of international standardization activities showed that the United States participates actively in some technical areas, but inadequately or not at all in others, which are of present and potential importance to our international trade. The United States has been handicapped in some world markets by its lack of participation in international standardization activities. Although it represents the United States in international standardization activities, ASA has not been given Government recognition as having this assignment.

The report therefore recommended that the U.S. Government officially recognize the proposed Institute as the body responsible for representing the interests of the United States in international standardization. Excepted were those activities subject to international treaties or those pursued between the Department of Defense and friendly foreign governments related to mutual defense.

The report indicated that financial support for the new Institute should come from sales of publications and services, dues and contributions from industry, and dues from participating memberships held by Government agencies. Limited financial support from the U.S. Government was proposed, when necessary. Government's participation in the management of the Institute would be by representation on its Board of Directors, with personnel appointed by the President and drawn from Government agencies concerned with standards.

Building codes were defined as a critical area for more comprehensive study than the panel was able to provide. The Federal Government has exerted some influence on building codes through the promotion and financing of building programs, and through the contributions of Government personnel working in this field, but it has not participated directly in the formulation of building codes.

It is technically feasible at this time, the report stated, to develop a uniform national voluntary building code that would accommodate the special needs of different regions. The report said that this could possibly be undertaken under the supervision and with the guidance of the National Bureau of Standards for subsequent promulgation by the Institute as a USA Code. Development of such a code would require cooperation by the existing model code organizations, and representatives of consumers, builders, architects, code enforcement officers, labor, and other groups having substantial interests.

The panel's report stressed the importance of clear lines of communications between Government, which is a major consumer, and industry, which produces items. The report recommended establishment of an interagency office to provide industry with ready access to information on Government standards.

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[1] *The report is available from the Clearinghouse for Federal Scientific and Technical Information, U.S. Department of Commerce, Springfield, Va. 22151. Section A, price $2, No. PB 166811; Section B, price $6, No. PB 166812. Section A contains major findings and recommendations. Section B contains reports of the various task forces.*

U.S. GOVERNMENT PRINTING OFFICE: 1965 O—769-938

Publications of the National Bureau of Standards

Periodicals

Technical News Bulletin, Vol. 49, No. 4, Apr. 1965. 15 cents. Annual subscription: $1.50; 75 cents additional for foreign mailing. Available on a 1-, 2-, or 3-year subscription basis.

CRPL Ionospheric Predictions for July 1965. Three months in advance. Number 28, issued Apr. 1965. 15 cents. Annual subscription: $2.50; 75 cents additional for foreign mailing. Available on a 1-, 2-, or 3-year subscription basis.

Journal of Research of the National Bureau of Standards

Section A. Physics and Chemistry. Issued six times a year. Annual subscription: Domestic, $4; foreign, $4.75; single copy, 70 cents.

Section B. Mathematics and Mathematical Physics. Issued quarterly. Annual subscription: Domestic, $2.25; foreign, $2.75; single copy, 75 cents.

Section C. Engineering and Instrumentation. Issued quarterly. Annual subscription: Domestic, $2.25; foreign, $2.75; single copy, 75 cents.

Section D. Radio Science. Issued monthly. Annual subscription: Domestic, $9; foreign, $11.50; single copy, $1.00.

Current Issues of the Journal of Research

J. Res. NBS 69C (*Eng. and Instr.*), *No. 2* (*Apr.–June 1965*).

Temperatures of thermocouple reference junctions in an ice bath. F. R. Caldwell.

Superimposed birefractory plates. L. H. Adams and R. M. Waxler.

A self-calibrating instrument for measuring conductance at radio frequencies. L. E. Huntley.

Exact inductance equations for rectangular conductors with applications to more complicated geometries. C. Hoer and C. Love.

Common volume of two intersecting cylinders. J. H. Hubbell.

Steady-state heat conduction in an exposed exterior column of rectangular cross section. B. A. Peavy.

Radio Sci. J. Res. NBS/URSI 69D, *No. 5* (*May 1965*).

Preface to fourth of "Waves in Plasma" papers. J. R. Wait.

On electromagnetic radiation from a magnetic dipole with arbitrary orientation embedded in a lossless magnetoionic medium. H. Motz.

A systematic study of the radiation patterns of a dipole in magnetoplasma based on a classification of the associated dispersion surfaces. R. Mittra and G. L. Duff.

Propagation of vertically polarized electromagnetic waves in a horizontally stratified magnetoplasma. R. Burman and R. N. Gould.

A note concerning the reflection of waves in inhomogeneous layers with asymmetric profiles. R. Burman.

On the terrestrial propagation of ELF and VLF waves in the presence of a radial magnetic field. J. Galejs.

Electron density profiles in cylindrical plasmas from microwave refraction data. B. A. Aničin.

Study of the waves supported by a warm plasma slab. P. R. Caron.

Transmission and reflection of electromagnetic waves by a hot plasma. E. C. Taylor.

Radiation from electrons in a magnetoplasma. H. B. Liemohn.

Radiation from a uniformly moving charge in an anisotropic, two component plasma. S. R. Seshadri and H. S. Tuan.

Other NBS Publications

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Standard Reference Materials: Sources of information, J. L. Hague, T. W. Mears, and R. E. Michaelis, NBS Misc. Publ. 260–4 (Feb. 1965), 20 cents.

Report of the 49th National Conference on Weights and Measures 1964, NBS Misc. Publ. 263 (Feb. 1, 1965), $1.00.

Technical highlights of the National Bureau of Standards, Annual Report 1964, NBS Misc. Publ. 264 (Dec. 1964), $1.00.

Ponderosa pine windows, sash, and screens (using single glass and insulating glass), NBS CS163–64 (Mar. 17, 1964) 15 cents. Supersedes CS163–59 and CS193–53.

Quarterly radio noise data September, October, November 1963, W. Q. Crichlow, R. T. Disney, and M. A. Jenkins, NBS Tech. Note 18–20 (Oct. 23, 1964), 50 cents.

Quarterly radio noise data, December, January, February 1963–64, W. Q. Crichlow, R. T. Disney, and M. A. Jenkins, NBS Tech. Note 18–21 (Jan. 25, 1965), 50 cents.

A tabulation of Airy functions, H. T. Dougherty and M. E. Johnson, NBS Tech. Note 228 (Sept. 18, 1964), 20 cents.

Table of attenuation as a function of vane angle for rotary-vane attenuators ($A = -40 \log_{10} \cos \theta$), W. Larson, NBS Tech. Note 229 (Jan. 7, 1965), $1.25.

Publications in Other Journals

This column lists all publications by the NBS staff, as soon after issuance as practical. For completeness, earlier references not previously reported may be included from time to time.

Reversal of the diurnal phase variations of GBR (16 kilocycles per second) observed over a path of 720 kilometers, D. D. Crombie and H. L. Rath, J. Geophys. Res. 69, No. 23, 5023–5027 (Dec. 1, 1964).

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Thermodynamics of hydrogen solubility in cryogenic solvents at high pressures, M. Orentlicher and J. M. Prausnitz, Book, Chem. Eng. Sci. 19, 775–782 (1964).

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Properties of normal and para hydrogen, R. B. Stewart and H. M. Roder, Book, Technology and Uses of Liquid Hydrogen, ed. R. B. Scott, W. H. Denton, and C. M. Nicholls, Ch. 11, 379–404 (Pergamon Press, Inc., New York, N.Y., 1964).

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The influence of metastable oxygen molecules on ozone and airglow, H. I. Schiff and L. R. Megill, J. Geophys. Res. 69, No. 23, 5120–5121 (Dec. 1, 1964).

Shape of the magnetospheric boundary under solar wind pressure, R. J. Slutz and J. R. Winkelman, J. Geophys. Res. 69, No. 23, 4933–4948 (Dec. 1, 1964).

Standards.—the foundation of industrial growth, R. D. Stiehler, Industrial Times VI, No. 22 (Bombay, India, Nov. 15, 1964).

Hyperfine structure of the $B^2\Sigma^+$ state of CN, H. E. Radford, Phys. Rev. 136, No. 6A, A1571–A1575 (Dec. 14, 1964).

Research for architecture, J. P. Eberhard, Res. News II, No. 1, 10–19 (Jan. 1965).

Spectral properties of plants, D. M. Gates, H. J. Keegan, J. C. Schleter, and V. R. Weidner, Appl. Opt. 4, No. 1, 11–20 (Jan. 1965).

Publications for which a price is indicated are available by purchase from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402 (foreign postage, one-fourth additional). Reprints from outside journals and the NBS Journal of Research may often be obtained directly from the authors.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Price 20 cents this special issue only. Regular issue 15 cents (single issue). Subscription price: domestic, $1.50 a year; 75 cents additional for foreign mailing. Use of funds for printing this publication approved by the Director of the Bureau of the Budget (June 19, 1961).

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